Electrocatalytic Behavior of Supported Palladium Electrodes on Vulcan.

- I. Avila (ESIQIE-IPN. Deparamento de Metalurgia), N. Alonso-Vante (Universite de Poitiers), and E.M. Arce (ESIQIE-IPN. Departamento de Metalurgia)

Introduction.

Highly dispersed high-surface-area catalyst are used in many heterogeneous catalytic and electrocatalytic processes. The electrocatalytic behavior of noble metal electrodes is of considerable importance viewpoint technological. To characterize the catalytic properties of supported metals, it is necessary to have information on the degree of dispersion of the supported metal and the effects of metal particle size of the supported metal [1]. The difficulty in such case must be caused mainly by the complexity of the structure of practical supported metal catalyst-electrodes. Hydrogen both adsorption and desorption processes have proved to be a useful means for the determination of the surface area of supported platinum and nickel electrodes. Platinum and palladium occur in the same group of the periodic table. It is usually assumed that they have similar electrochemical properties [1-2]. However, they show a significant differences. Palladium has the ability to absorb big quantities of hydrogen at room temperature [3]. This work provides information about the behavior of nanometric size palladium support on a vulcan XC-72 using as model reactions: hydrogen adsorption-desorption and oxygen reduction.

Experimental.

Commercial Pd supported powders from E-Tek were used. Electrodes with different compositions (1. 5. 10, 30 %Pd) were prepared using glassy carbon (GC) as substrates. The electrodes (Pd/GC) were prepared as follow: Pd-containing powder was mixed in desionized water with ultrasonic agitation. The emulsions were dispersed on glassy carbon using Nafion. Prior to dispersion the GC surface was polish with a fine alumina suspension down to 0.03 μm, thereafter, sonicated in acetone and deionized water.

Electrochemical measurements were carried out at room temperature in a glass cell containing 0.5M H_2SO_4. A flow of highly purified nitrogen gas was bubbled into the solution during the electrochemical experiments of hydrogen adsorption-desorption, and with oxygen during the reduction of oxygen. The counter and reference electrodes were a platinum wire and a Hg/Hg_2SO_4, respectively. The potential control was performed using a Potentiostat-Galvanostat Autolab.

Results.

Figures 1-4 show typical cyclic voltammograms for four Pd/GC (1, 5, 10 y 30% wt Pd). The cyclic voltammogram of 1%Pd /GC electrode, no significant surface redox reactions are observed over the explored potential range. On other hand, the cyclic voltammogram recorded with 10 %Pd/GC electrode shows an interesting feature: appearance of peaks at ~ -0.4V/Hg/Hg_2SO_4 similar to the so-called anomalous hydrogen peak.

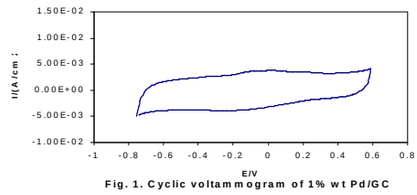

Fig. 1. Cyclic voltammogram of 1% wt Pd/GC

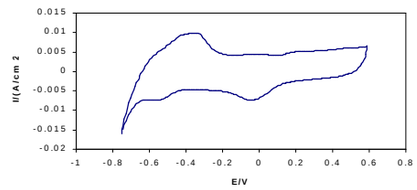

Fig.2. Cyclic voltammogram of 5% wt Pd/GC

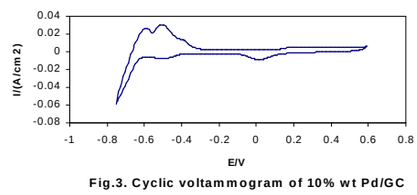

Fig.3. Cyclic voltammogram of 10% wt Pd/GC

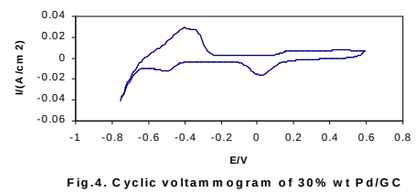

Fig.4. Cyclic voltammogram of 30% wt Pd/GC

Figure 5 shows the cathodic disk current density as a function of applied electrode potential to the disk electrode from 0.3 to 0.650 V (Hg/Hg_2SO_4) at scan rate of 5mVs^{-1} and various rotating speeds.

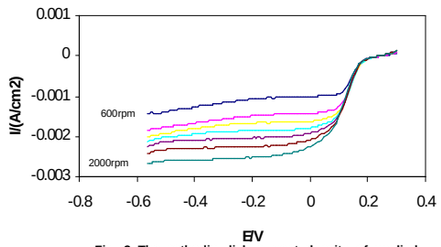

Fig. 3 The cathodic disk current density of applied potential obtained from sweeping at various rotating speeds

References

1. L.D. Burke and J.K. Casey. J. Appl. Phys., **23,** 573 (1993).
2. N. Tateshi and K. Yahikozawa, Electrochim. Acta, **36,** 1235(1991).
3. P. L .Cabot, E. Guezala, and J.C. Calpe, J. Electrochem. Soc.,**147,** 43 (2000).